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Observations on the life history of *Eukoenenia chilanga* Montaño (Arachnida: Palpigradi)

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Abstract. The life history of a palpigrade is reconstructed through morphological and morphometric multivariate analyses applied to a series of 37 individuals collected in a single locality in Tlalnepantla, Estado de México, during different seasons. Those analyses reveal the presence of three life stages: protonymph, deutonymph and adult. Morphologically, males and females can be distinguished as deutonymphs and adults. Morphometrically the sexes can be recognized in all of the life stages, unprecedented for the family Eukoeniidae.

Keywords: Palpigrades, partial life history, sexual dimorphism

Our current knowledge of the life history of palpigrades is quite limited and slightly confusing because of the terminology chosen by former authors. Living members of the order Palpigradi are classified into two different families: Prokoeneniidae Condé and Eukoeneniidae Petrunkevitch, which differ in their life histories. Rucker (1903) presented the first life history of a palpigrade, specifically that of *Prokoeninia wheeleri* (Rucker) from Texas, USA. This species has four life stages, which she named: "First Known Stage", "Second Stage", "Last Stage", and "Adult". Subsequently, Van der Hammen (1982), reviewing Rucker's findings, indicated that the first known instar had no opisthosomatic papillae, two pairs in the second known, and three pairs in the third known instar and in adults. Van der Hammen then speculated that because "There is an important gap between the sizes of Rucker's first and second known instars, and the occurrence of an instar of intermediate size, with one pair of papillae, seems highly probable." Finally, he proposed the existence of a prelarva (without any supporting evidence), a larva (Rucker's first known instar, without papillae), a protonymph (speculative, with one pair of papillae), a deutonymph (Rucker's second instar), a tritonymph (Rucker's third instar) and the adult; thus, from Rucker's four observed instars, Van der Hammen stretched *Prokoenenia* life history to include six stages! Condé (1984) working with *Eukoenenia* proposed that these palpigrades have one instar less than prokoeneniids, but named them as follows: Immature A (sexes not recognizable), Immature B (female subadult), Immature C (male subadult), and adults (male and female); that is, three instars but with different terms between female (B) and male (C) subadults. He further proposed that in prokoeneniids, the Immature A stage is divided into two subsets A_1 and A_2 (Condé 1984, 1996, 1998), which is rather confusing: B and C represent the same instar, whereas A_1 and A_2 represent two consecutive instars.

A preliminary morphological analysis of a series of 12 specimens of *Eukoenenia chilanga* Montaño 2012 collected on 13 June 2003 north of Mexico City suggested the presence of three distinct instars in the field (Table 1; also, see Montaño 2006). Therefore, extra collecting efforts were carried out in 2006–2007, and a comprehensive morphometric analysis was undertaken.

METHODS

The palpigrades were hand collected at Picacho el Jaral, Tlalnepantla, Estado de México, located in the northern reaches of Mexico City (99°56.8886′N, 106°98.888′W, 2345 m). Collection events were restricted to the rainy season (as attempts to locate them during the dry season were unproductive) as follows: 13 June 2003, 13 July 2006, 2 July 2006, 20 November 2006, 6 July 2007, 19 August 2007 and 23 September 2007.

Specimens were fixed in 80% ethanol in the field. They were cleared with lactophenol (50% lactic acid, 25% phenol crystals and 25% distilled water) for about 1 min, and were mounted with Hoyer's (50 ml distilled water, 30 g Arabic gum, 200 g chloral hydrate and 20 ml glycerine) on semi-permanent preparations on individual slides with cover slips. These were dried in an oven for one week at 50 °C, after which the excess Hoyer's liquid was removed with a razor blade, the cover slip was sealed with fingernail polish, and the slide was labeled. The specimens are deposited in the Colección Nacional de Arácnidos (CNAN), Instituto de Biología, Universidad Nacional Autónoma de México (UNAM).

Specimens were studied under interference phase contrast on a Nikon Optiphot II microscope equipped with an ocular micrometer. The terminology for all structures, including setae, follows Van der Hammen (1989). The characters used for the multivariate analyses were selected on the basis of low perceived deformation on the specimens due to the clearing and mounting technique. A matrix with 27 characters for 34 specimens was produced. The sample contains 12 adults (7 females and 5 males) and 25 immatures, 15 subadults, of which 5 are pre-males (13, 14, 15, 19, 22) and 10 pre-females (16, 17, 18, 20, 21, 23, 24, 25, 26, 27), and 10 nymphs (Appendix 1). The multivariate analyses were performed with the program NTCYSpc version 2.1 (Rohlf 2004), using Principal Component Analysis (PCA), because most of the data are quantitative. PCA graphics were generated showing the dispersion of the operational taxonomic units (OTUs) on the sampling space.

Results from the multivariate analyses were used to calculate "estimated growth ratios" to test for the existence of the presumptive additional instar proposed by Van der

Table 1.—Dates and number of specimens of *Eukoenenia chilanga* collected between 2003 and 2007.

Date	Numbers	Life stages		
		Protonymph	Deutonymph	Adults
13 June 2003	12	2	3	5 ♂, 2 ♀
13 June 2006	5	0	2	2 ♂, 1 ♀
02 July 2006	17	3	3	10 ♂, 1 ♀
20 November 2006	4	1	1	1 ♂, 1 ♀
06 July 2007	19	2	1	4 ♂, 12 ♀
19 August 2007	35	2	8	13 ♂, 14 ♀
23 September 2007	8	0	0	5 ♂, 3 ♀
TOTALS	102	10	18	40 ♂, 34 ♀

Hammen (1982). The growth rate in linear (unidimensional) structures in arthropods is known as Dyar's constant and is the cube root of 2, or 1.26 (Francke & Sissom 1984); thus, if an extra instar occurred between the first and second observed sizes, as hypothesized by Van der Hammen, the growth factor between those first and second observed sizes should be 1.26 ×2 = 1.59. The meristic characters (lengths in microns) chosen for these tests were those that showed the highest correlation ($r < 0.96$), and they are basal cheliceral segment, tibia IV, patella IV, basitarsus IV, pedipalp tibia and basitarsus 2 of leg III. The binomial test was used to determine whether the observed frequency of males and females deviated from an expected 50:50 sex ratio (Siegel 1956).

According to Condé's terminology, our "juveniles" correspond to his "A stage", our "subadult females" to the "B stage", and our "subadult males" to the "C stage" in Eukoeneniidae. However, we find the terminology cumbersome and uninformative and propose instead to use the widely accepted "protonymph", "deutonymph (male or female), and "adult".

RESULTS

A total of 102 specimens was collected, 74 adults and 28 immatures, as summarized in Table 1. A detailed morphological analysis of 27 "near-perfect" specimens is summarized in Table 2. Five of the seven characters listed [number of lateral organs, number of deutotritosternal (ep. P) setae, number of lateroventral (lv) setae on sternites X and XI, and number of dorsal (d) setae on tergite XIII] clearly allow the recognition of three distinct morphs, ranked in decreasing size: 1) those with 3 pairs of lateral organs, 5 ep. P, 2 + 2 lv on sternites X and XI, and 2 + 1 + 2 d on tergite XIII; which have developed external genitalia and are clearly adults (Figs. 1 A & B); 2) those with 2 pairs of lateral organs, 3 ep. P, 1 + 1 lv on sternites X and XI, and 1 + 1 + 1 d on tergite XIII; and which have partially differentiated external genitalia and are subadults (Figs. 2 A & B); and finally (3) those with 1 pair of lateral organs, 1 ep. P, no lv seta on sternites X and XI, and 1 + 1 d setae on tergite XIII; and without any modifications on sternites X and XI; i.e., no genitalic differentiation whatsoever (Fig. 2C). Furthermore, on the largest morphs or adults (#1 above), we can recognize two subgroups based on two additional characters in Table 2 [number of ventral (v) setae on sternites X and XI]: 1a) with 5–6 + 0 + 5–6 v setae and 1b) those with 3 + 0 + 3 v setae; which allows the separation of males and females, respectively, without having to examine the genitalia (Figs. 1 C & D). In the last two characters [number of ventral (v) setae on sternites X and XI] adult females resemble subadults (of both sexes), adult males have additional setae, and juveniles have fewer setae. In the intermediate, or subadult, age class, the characters presented in Table 2 do not allow the separation of the sexes, whereas that can be done by examination of the genital plates (Figs. 2 A & B). However, one of the specimens in Table 2, with 2 ep.P setae (usually 1 ep.P in protonymphs and 3 in deutonymphs), and with 2+0+2 v setae on sternite X (usually 2+2 in protonymphs and 3+0+3 in deutonymphs), suggested the possibility of an additional, "rare" instar, between our proposed protonymphs and deutonymphs. Therefore, a Principal Components Analysis of the sizes observed was undertaken to evaluate such a possibility. The results from the PCA analysis are summarized in Table 3, which shows the eigenvalues (right side of the table), and the first component accounts for 88.1% of the variation observed in the sample, and adding the second component raises the value to 90.3%. The eigenvectors (Table 3, left side) show that most values are above 0.9 (or

Table 2.—Results of morphological comparisons in specific structures among palpigrades of different sizes (and age classes) in *Eukoenenia chilanga* from Mexico City (m = adult male, f = adult female, dm = deutonymph male, df = deutonymph female, p = protonymph).

N° of exemplars (Total = 27)	Sex/age	N° of lateral lobes	N° of deutotritosternal (*ep.P*) setae	X		XI		XIII
				Ventral		Ventral		Dorsal
				lv	v	lv	v	d
1	m	3	5	2+2	5+0+5	2+2	5+0+5	2+1+2
1	m	3	5	2+2	5+0+5	2+2	6+0+6	2+1+2
2	m	3	5	2+2	6+0+5	2+2	5+0+5	2+1+2
1	m	3	5	2+2	6+0+6	2+2	6+0+5	2+1+2
1	f	3	4	2+2	3+0+3	2+2	3+0+3	2+1+2
2	f	3	5	2+2	3+0+3	2+2	3+0+3	2+1+2
1	f	3	5	2+2	3+0+3	2+2	3+0+3	3+1+3
1	f	3	6	2+2	3+0+3	2+2	3+0+3	2+1+2
6	dm	2	3	1+1	3+0+3	1+1	3+0+3	1+1+1
6	df	2	3	1+1	3+0+3	1+1	3+0+3	1+1+1
1	p	1	2	0	2+0+2	0	2+2	1+1
4	p	1	1	0	2+2	0	2+2	1+1

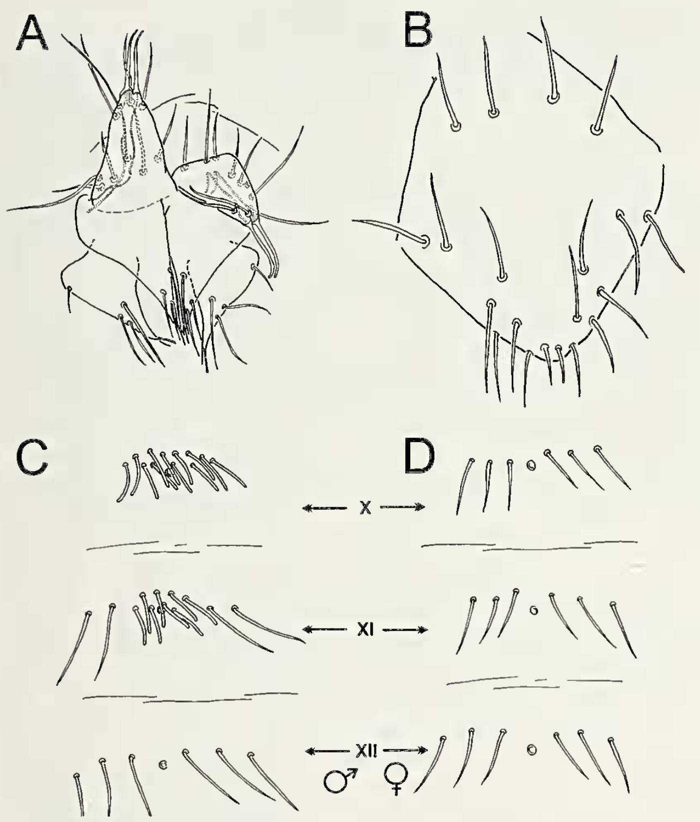

Figure 1.—Sex recognition in adult *Eukoenenia chilanga*, from Tlanepantla, Estado de México. Genital plates. A. Male; B. Female; ventral setae on sternites X, XI and XII; C. Male (X = 6+0+6, XI = 6+0+6, XII = 3+0+3); D. Female (X = 3+0+3, XI = 3+0+3, XII = 3+0+3).

very close to it) in the first component, accounting for most of the variation observed; those characters are shown in bold type in Table 3. Clearly the most important component in the variation observed is size-related; i.e., the PCA analysis is recognizing distinct instars or age classes in the sample analyzed.

The graph of the dispersion of the samples along the two principal components from the PCA analysis (Fig. 3) shows three distinct size classes on the ordinate, corresponding to the protonymphs, deutonymphs and adults. Thus, one of the specimens in Table 2 (above), despite its variation in two setal counts, is clearly a protonymph with only one pair of lateral organs. Furthermore, the abscissa of the graph shows the morphometric differences due to sexual dimorphism, which manifest as early as in the protonymphs, with females toward the top of the scatter plots, and males lower.

Because of the marked sexual dimorphism in the three life stages observed, we calculated average measurements for six structures separately for males and females and then proceeded to calculate the average growth factor observed between instars for each sex. The results are shown in Table 4, and in general the growth factors are lower than the expected 1.26, and certainly there are no values approaching the 1.59 growth factor implied by Van der Hammen when he proposed an intermediate, additional instar between the protonymph and the deutonymph. Finally, it is noteworthy that in this species the sex ratio is approximately equal (40 males, 34 females) and does not differ significantly from an expected 50:50 ratio ($z = 0.58$, $P = 0.281$).

DISCUSSION

The life history of eukoeneniids is apparently quite simple and consists of only three active instars: protonymph, deutonymph and adult. Protonymphs (Condé's stage A) cannot be reliably sexed based on external morphology, whereas deutonymphs (Condé's stages B for females and C for males) can be easily separated, as can the adults. These three instars can be readily recognized by a number of morphological characters, and are morphometrically quite distinct.

The life history of prokoeneniids is also apparently quite simple and consists of four active instars: protonymph (Rucker's "First Known Stage"), deutonymph (Rucker's "Second Stage"), tritonymph (Rueker's "Last Stage before the adult") and adult. There is no evidence whatsoever for a "prelarva" as proposed by Van der Hammen, nor is there any support for the intermediate instar (between Rucker's First and Second Stages) that the same author proposed. Examination of the "size-comparable" figures in Rucker's paper, drawn at the same scale and magnification, show only that the full, ventral views of the abdomen are comparable. Based on measurements obtained from a printed copy of 39mm, 55mm, 65mm and 71mm in total length; we obtain growth factors of 1.41, 1.18 and 1.09 between proto- and deuto-, between deuto- and tritonymph, and between tritonymph and adult, which is a rather high growth factor for the first molt.

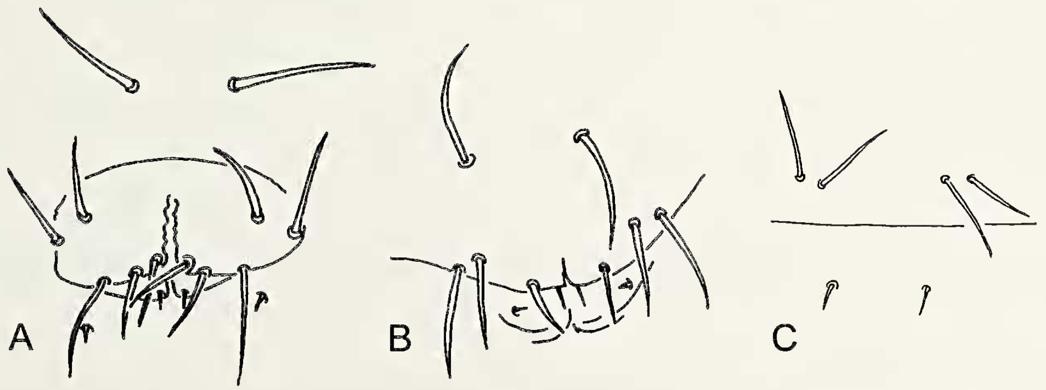

Figure 2.—Sex determination in juvenile *Eukoenenia chilanga*, from Tlanepantla, Estado de México. Genital region.- A. Male deutonymph, B. Female deutonymph, C. protonymph.

Table 3.—Results from the principal component analysis for the palpigrades from Tlalnepantla, Estado de México. Eigenvalues on the left, and eigenvectors on the right-hand columns, respectively. Bold type indicates the characters that account for most of the variation in the PCA analysis.

Eigenvalues					Eigenvectores		
Eigenvalue (Total = 27.00000)	Percentage	Cumulative	#	Characters	C1	C2	C3
23.7882	**88.1045**	**88.1045**	1	**number of ventral setae on propeltidium**	**0.9742**	0.0209	0.0086
0.59833	**2.2160**	**90.3206**	2	**number of lateral organs**	**0.9850**	0.0283	0.0190
0.42266	1.5654	91.8860	3	**number of ventral setae on sternite X**	**0.9094**	−0.1780	0.2370
0.39163	1.4505	93.3364	4	**number of ventral setae on sternite XI**	**0.9070**	−0.2016	0.2288
0.27035	1.0013	94.3377	5	**number of ventral setae on sternite XII**	**0.9586**	0.07120	0.0909
0.22416	0.8302	95.1679	6	**length of basal segment of chelicera**	**0.9883**	0.0050	0.0312
0.20227	0.7492	95.9171	7	**length of medial seta on basal segment of chelicera**	**0.9346**	−0.1030	−0.1304
0.18575	0.6880	96.6051	8	**length of movable finger of chelicera**	**0.9242**	0.0813	−0.0755
0.15756	0.5836	97.1886	9	**length of pedipalp trochanter**	**0.9548**	0.1138	−0.0059
0.13787	0.5106	97.6993	10	**length of pedipalp tibia**	**0.9684**	0.1740	0.0297
0.11565	0.4283	98.1276	11	**length of trochanter I**	**0.9570**	0.0270	0.1303
0.08795	0.3257	98.4533	12	length of latero-dorsal seta on trochanter I	0.8205	−0.1047	0.3072
0.08052	0.2982	98.7516	13	**length of tibia I**	**0.9506**	0.1695	0.0031
0.06326	0.2343	98.9858	14	**length of the solenidium on basitarsus 3 of leg I**	**0.9413**	−0.0769	−0.1336
0.05763	0.2135	99.1993	15	length of dorso-proximal seta on basitarsus 7 of leg II	0.8999	−0.1669	−0.1435
0.04512	0.1671	99.3664	16	**length of basistarsus 2 on leg II**	**0.9487**	0.1557	−0.1284
0.03633	0.1346	99.5010	17	**length of dorsolateral seta on trochanter III**	**0.9074**	−0.0954	−0.2637
0.03236	0.1198	99.6208	18	**length of tibia III**	**0.9129**	0.2440	0.0027
0.03012	0.1115	99.7324	19	**length of ventro-lateral seta on tibia III**	0.8904	−0.3014	−0.0167
0.02481	0.0919	99.8243	20	**length of basitarsus 2 on leg III**	**0.9667**	0.1127	0.0780
0.01551	0.0575	99.8817	21	length of solenidium on basitarsus 3 of leg III	0.8938	−0.2250	−0.1518
0.01245	0.0461	99.9278	22	**length of patella IV**	**0.9798**	0.1323	0.0255
0.00717	0.0266	99.9544	23	**length of tibia IV**	**0.9823**	0.1160	0.0137
0.00566	0.0210	99.9753	24	**length of ventrodistal seta on tibia IV**	**0.9005**	−0.2561	−0.0633
0.00359	0.0133	99.9886	25	**length of basitarsus 1 on leg IV**	**0.9691**	0.0619	0.0400
0.00181	0.0067	99.9954	26	**length of insertion of solenidium on basitarsus 1 on leg IV**	**0.9400**	0.1776	−0.0920
0.00125	0.0046	> 100%	27	**length of the solenidium on basitarsus 1 of leg IV**	**0.9574**	−0.0777	−0.0255

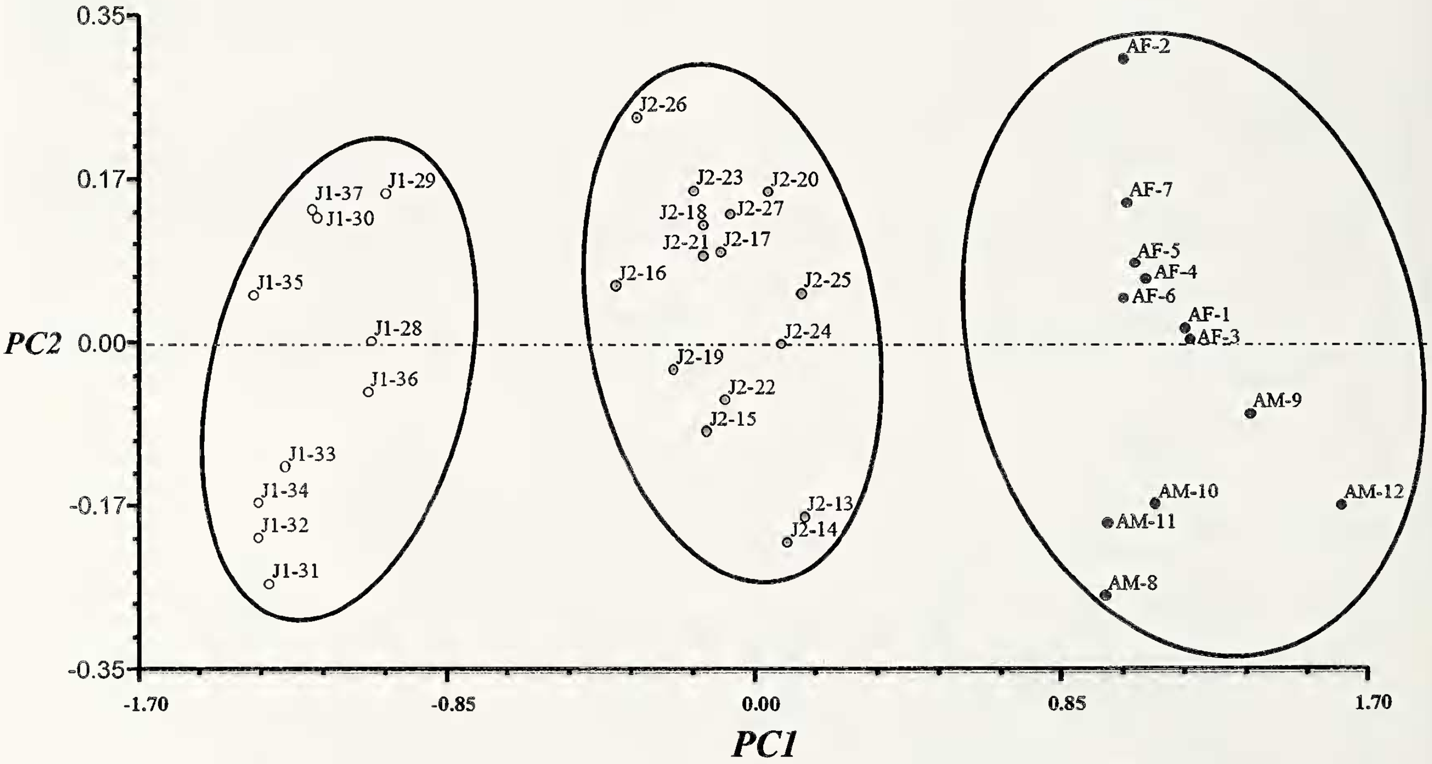

Figure 3.—Ontogeny of *Eukoenenia chilanga*. Graphic representation of the results of the principal components analysis showing the separation of three age classes (from left to right protonymph, deutonymph and adult) along the ordinate, and the separations by sexes along the abscissa (males below 0, females above 0; AF = adult female, AM = adult male).

Table 4.—Calculation of growth factors (GF) between instars for six different structures (lengths in microns) in female and male palpigrades (XP =average in protonynphs, XD = average in deutonynphs, XA = average in adults).

	Characters	XP	GF	XD	GF	XA
♀	Basal cheliceral segment	92.48	1.193	108.96	1.178	130.05
	Tibia IV	63.68	1.218	77.28	1.213	94.17
	Patela IV	68.16	1.172	82.08	1.204	96.22
	Basitarsus IV	50.56	1.168	64.96	1.284	75.88
	Pedipalp tibia	65.28	1.185	80.8	1.237	95.77
	Basitarsus 2 on leg III	41.92	1.206	53.6	1.278	64.68
♂	Basal cheliceral segment	131.52	1.208	108.8	1.227	88.64
	Tibia IV	93.44	1.242	75.2	1.270	59.2
	Patela IV	96.64	1.203	80.32	1.267	63.36
	Basitarsus IV	77.12	1.181	65.28	1.333	48.96
	Pedipalp tibia	95.68	1.245	76.8	1.311	58.56
	Basitarsus 2 on leg III	63.68	1.213	52.48	1.378	38.08

However, if we measure the width of the genital sternite we obtain 1.5mm, 1.7mm, 1.9mm and 2.2mm for corresponding growth factors of 1.13, 1.12 and 1.16—closer to those we observed in *E. chilanga*. It is known that the length of the abdomen varies with the feeding condition of the animals, and this probably explains the "important gap between the sizes of Rucker's first and second known instars", which prompted Van der Hammen to propose the existence of an intermediate, additional instar in the life history of prokoeneniids.

The sex ratio in many palpigrades is highly skewed toward females (Condé 1984), to the extent that parthenogenesis has been suggested as a possible explanation for the lack, or near lack, of males in some populations. However, in *E. chilanga* the sex ratio observed does not deviate significantly from 50:50.

It is necessary to emphasize that the terminology used by Bruno Condé for the life stages or instars (A1, A2, B and C), are atypical in the terminology widely accepted for the Class Arachnida, so the authors request that the arachnological community homologize those terms and in the future refer to palpigrade life stages as protonymph, deutonymph, tritonymph (when present, as in the case of *Prokoenenia*) and adult.

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Appendix 1.—Data base matrix of the principal component analysis.

	Characters	AF-1	AF-2	AF-3	AF-4	AF-5	AF-6	AF-7
1	Number of ventral setae on propeltidium	5	5	6	4	5	5	5
2	Number of lateral organs	3	3	3	3	3	3	3
3	Number of ventral setae on sternite X	10	10	10	10	10	10	10
4	Number of ventral setae on sternite XI	10	10	10	10	10	10	10
5	Number of ventral setae on sternite XII	10	10	10	10	10	10	10
6	Length of basal segment of chelicera	132.8	128	136	132.8	128	124.8	128
7	Length of medial seta on basal segment of chelicera	62.4	57.6	64	62.4	57.6	59.2	60.8
8	Length of movable finger of chelicera	81.6	80	78.4	83.2	80	75.2	81.6
9	Length of pedipalp trochanter	88	96	94.4	91.2	91.2	92.8	91.2
10	Length of pedipalp tibia	96	96	96	96	96	92.8	97.6
11	Length of trochanter I	84.8	88	83.2	84.8	81.6	84.8	80
12	Length of latero-dorsal seta on trochanter I	83.2	64	81.6	80	80	73.6	72
13	Length of tibia I	102.4	104	100.8	99.2	99.2	100.8	104
14	Length of the solenidium on basitarsus 3 of leg I	35.2	35.2	33.6	33.6	33.6	35.2	35.2
15	Length of dorso-proximal seta on basitarsus 7 of leg II	65.6	70.4	72	68.8	68.8	68.8	65.6
16	Length of basistarsus 2 on leg II	59.2	57.6	60.8	59.2	56	56	57.6
17	Length of dorsolateral seta on trochanter III	88	91.2	96	96	91.2	88	91.2
18	Length of tibia III	57.6	56	51.2	54.4	56	52.8	56
19	Length of ventro-lateral seta on tibia III	38.4	27.2	33.6	33.6	32	32	33.6
20	Length of basitarsus 2 on leg III	65.6	62.4	68.8	62.4	65.6	64	64
21	Length of solenidium on basitarsus 3 of leg III	27.2	24	25.6	24	25.6	25.6	25.6
22	Length of patella IV	99.2	99.2	92.8	94.4	96	96	96
23	Length of tibia IV	96	96	94.4	91.2	91.2	94.4	96
24	Length of ventrodistal seta on tibia IV	32	28.8	32	32	32	32	28.8
25	Length of basitarsus 1 on leg IV	75.2	76.8	73.6	76.8	75.2	78.4	75.2
26	Length of insertion of solenidium on basitarsus 1 on leg IV	38.4	40	40	40	40	38.4	36.8
27	Length of the solenidium on basitarsus 1 of leg IV	41.6	41.6	43.2	40	41.6	43.2	41.6

Appendix 1.—Extended.

AM-8	AM-9	AM-10	AM-11	AM-12	J2-13	J2-14	J2-15	J2-16	J2-17	J2-18	J2-19	J2-20	J2-21	J2-22
5	5	5	5	5	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	2	2	2	2	2	2	2	2	2	2
13	14	16	15	17	8	8	8	8	8	8	8	8	8	8
16	16	15	14	16	8	8	8	8	8	8	8	8	8	8
10	10	10	10	10	8	8	8	8	8	8	8	8	8	8
128	132.8	129.6	129.6	137.6	115.2	112	110.4	107.2	110.4	107.2	100.8	108.8	107.2	105.6
56	56	60.8	62.4	62.4	52.8	56	51.2	46.4	51.2	52.8	46.4	49.6	48	46.4
80	81.6	80	76.8	70.4	65.6	70.4	67.2	67.2	68.8	70.4	65.6	67.2	65.6	68.8
83.2	89.6	91.2	86.4	102.4	78.4	80	78.4	72	76.8	75.2	76.8	81.6	78.4	78.4
92.8	99.2	96	91.2	99.2	76.8	75.2	75.2	75.2	76.8	80	78.4	84.8	80	78.4
83.2	88	86.4	80	94.4	72	76.8	78.4	72	75.2	67.2	72	67.2	70.4	72
75.2	83.2	73.6	76.8	84.8	76.8	70.4	67.2	67.2	68.8	68.8	62.4	68.8	62.4	60.8
96	105.6	102.4	96	102.4	86.4	75.2	76.8	81.6	83.2	86.4	83.2	88	88	86.4
35.2	36.8	33.6	33.6	38.4	28.8	32	28.8	25.6	27.2	28.8	27.2	32	30.4	32
68.8	72	62.4	65.6	72	60.8	64	59.2	52.8	57.6	56	56	59.2	60.8	64
51.2	60.8	56	51.2	60.8	46.4	46.4	46.4	43.2	48	51.2	46.4	52.8	43.2	49.6
89.6	96	88	91.2	97.6	86.4	86.4	81.6	73.6	80	80	78.4	84.8	73.6	83.2
48	56	51.2	51.2	57.6	46.4	43.2	41.6	44.8	48	41.6	41.6	48	48	41.6
33.6	35.2	36.8	33.6	38.4	32	30.4	28.8	27.2	22.4	24	25.6	24	24	28.8
60.8	68.8	62.4	57.6	68.8	51.2	54.4	52.8	51.2	54.4	52.8	49.6	52.8	52.8	54.4
27.2	27.2	25.6	25.6	27.2	25.6	24	20.8	19.2	22.4	20.8	24	24	24	20.8
89.6	102.4	94.4	92.8	104	84.8	80	80	76.8	83.2	81.6	78.4	84.8	83.2	78.4
88	96	94.4	88	100.8	76.8	73.6	75.2	72	78.4	76.8	76.8	78.4	75.2	73.6
32	32	32	32	33.6	28.8	27.2	27.2	25.6	27.2	24	27.2	24	24	28.8
73.6	83.2	73.6	72	83.2	72	64	62.4	59.2	62.4	64	64	67.2	65.6	64
36.8	36.8	33.6	40	41.6	33.6	33.6	30.4	30.4	32	33.6	32	35.2	32	32
41.6	38.4	44.8	40	46.4	36.8	38.4	35.2	32	33.6	35.2	35.2	33.6	35.2	33.6

Appendix 1.—Extended.

J2-23	J2-24	J2-25	J2-26	J2-27	J1-28	J1-29	J1-30	J1-31	J1-32	J1-33	J1-34	J1-35	J1-36	J1-37
3	3	3	3	3	2	1	1	1	1	1	1	1	1	1
2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
8	8	8	8	8	4	4	5	4	4	4	4	4	4	4
8	8	8	8	8	4	4	4	4	4	4	4	4	4	4
8	8	8	8	8	4	4	4	4	4	4	4	4	4	4
110.4	110.4	112	108.8	107.2	94.4	92.8	94.4	89.6	89.6	88	84.8	91.2	91.2	89.6
49.6	49.6	49.6	44.8	49.6	46.4	46.4	40	46.4	43.2	43.2	41.6	40	43.2	41.6
68.8	72	64	67.2	60.8	59.2	60.8	60.8	56	56	57.6	57.6	59.2	59.2	57.6
83.2	83.2	80	80	80	62.4	67.2	67.2	67.2	67.2	57.6	56	62.4	67.2	64
83.2	83.2	83.2	80	81.6	68.8	68.8	57.6	54.4	54.4	62.4	54.4	64	67.2	67.2
76.8	76.8	80	72	73.6	62.4	64	60.8	59.2	59.2	59.2	54.4	60.8	60.8	62.4
70.4	65.6	92.8	65.6	64	59.2	60.8	59.2	56	59.2	62.4	57.6	56	54.4	49.6
83.2	89.6	89.6	80	84.8	75.2	72	67.2	52.8	64	75.2	60.8	67.2	72	72
27.2	32	30.4	25.6	30.4	27.2	22.4	24	24	24	22.4	25.6	24	27.2	24
56	57.6	62.4	56	56	49.6	51.2	48	60.8	56	52.8	51.2	49.6	49.6	51.2
46.4	46.4	46.4	43.2	49.6	41.6	41.6	40	35.2	33.6	38.4	38.4	36.8	40	43.2
68.8	88	75.2	76.8	83.2	72	76.8	72	70.4	68.8	78.4	70.4	65.6	72	72
46.4	41.6	46.4	46.4	48	41.6	43.2	43.2	36.8	35.2	33.6	38.4	35.2	38.4	40
24	25.6	25.6	22.4	20.8	24	19.2	19.2	24	17.6	17.6	24	19.2	20.8	20.8
56	54.4	57.6	52.8	51.2	43.2	46.4	43.2	36.8	35.2	38.4	43.2	38.4	36.8	38.4
20.8	24	20.8	19.2	22.4	19.2	17.6	19.2	19.2	20.8	19.2	19.2	17.6	20.8	19.2
81.6	83.2	83.2	80	83.2	65.6	70.4	72	64	62.4	62.4	59.2	65.6	68.8	67.2
73.6	80	81.6	76.8	80	64	64	67.2	57.6	59.2	57.6	57.6	62.4	64	60.8
25.6	27.2	27.2	22.4	28.8	24	24	20.8	22.4	24	24	22.4	20.8	27.2	19.2
62.4	67.2	73.6	62.4	65.6	51.2	54.4	46.4	46.4	48	46.4	48	48	56	52.8
30.4	32	33.6	32	35.2	25.6	30.4	27.2	24	22.4	24	24	25.6	28.8	28.8
33.6	36.8	36.8	32	33.6	25.6	28.8	25.6	25.6	27.2	30.4	28.8	27.2	30.4	28.8